RK
& Associates, Inc.

July 23, 2010

R10364-4

Mr. Joseph Ulfig, P.E.
Air and Radiation Division
United State Environmental protection Agency – Regions 5
AE-17J
778 West Jackson Boulevard
Chicago Illinois 60604-3590

Via Overnight Delivery

Winnebago Landfill Facility
Notice of Violation – EPA-5-10-07-IL
Response Letter to July 8, 2010 Meeting

Dear Mr. Ulfig;

On behalf of Winnebago Reclamation Service ("WRS"), we thank you and the other U.S. Environmental Protection Agency ("USEPA") officials for meeting with us on July 8th to address the above-referenced Notice and Finding of Violation ("NOV"). As committed during our meeting discussions, WRS is providing the supplemental information to answer questions raised by EPA and to further clarify our position regarding the allegations of the NOV. The information presented herein should be considered as supplemental information to WRS' initial written response dated April 9, 2010. We understand that EPA officials will review the enclosed and attached supplemental information in furtherance of reaching an agreement for resolution of the compliance questions raised by the NOV.

The following is a summary of the items addressed in this submittal. Detailed information for each item is provided in Attachments 1 – 4 to this letter:

- North Flare Compliance Status (Attachment 1)
- Gas Collection System Design Review (Attachment 2)
- Demonstration of Compliance with SO_2 Concentration Limit of 35 IAC 214.301 (Attachment 3).
- Flare Relocation Design and Operations Summary (Attachment 4).

North Flare Compliance Status (Attachment 1)

Paragraph 31 of the NOV alleged that sulfur dioxide ("SO2") emissions from the North Flare exceeded the permitted emission limit. During the initial March 9th conference and in WRS' April 9th written response to the NOV, WRS presented 2008 and 2009 data and emissions calculations to demonstrate that SO2 emissions from the North Flare had not exceeded the permit limit .

2 South 631 Route 59; Suite B
Warrenville, IL 60555
(630) 393-9000
Fax (630) 393-9111

RK & Associates, Inc.

During our recent meeting, you noted that certain landfill gas data was not used in the SO2 compliance demonstration for the North Flare. WRS representatives explained that data, which had been included in permit application materials, was not valid, accurate, or reliable and therefore, was properly excluded from the compliance demonstration. USEPA officials asked for an explanation of why it was determined that data was invalid. Set forth in Attachment 1 is background information regarding the subject landfill gas data and a detailed explanation of how and why WRS determined that data was not representative of actual landfill gas quality from the closed North Unit.

Gas Collection System Design Review (Attachment 2)

During our July 8th meeting, you questioned whether the landfill gas collection system installed by WRS in the South Unit was sufficient to control fugitive emissions. Questions or concerns about the adequacy of the collection system were based on your review of other municipal solid waste landfills, although details regarding which landfills and site-specific details were not discussed.

USEPA's questions or concerns about the adequacy of the landfill gas collection system installed and operated to capture landfill gas from the South Unit are unfounded. WRS is confident that its gas collection system design meets the requirements of all applicable regulatory standards and, in fact, achieves significantly better collection and control than typical systems installed at other landfills within Region V. Supporting documentation for our position is provided in Attachment 2. As stated previously WRS has and will continue to conduct its operations in a manner consistent with good air pollution control practice, including the design, early installation, and operation of the gas collection systems, in a manner that exceeds the goals (either expressed or implied) in any applicable regulation or permit condition.

Demonstration of Compliance with SO_2 Concentration Limit of 35 IAC 214.301 (Attachment 3)

During our recent meeting, USEPA officials reiterated their preference for actual emissions testing data to demonstrate compliance with 35 Ill. Admin. Code 214.301, which limits SO2 emissions from certain "process emission sources" to 2000 ppm. The agency's position was previously communicated to WRS in response to detailed combustion calculations, utilizing actual data of hydrogen sulfide ("H2S") concentrations in landfill gas, that demonstrated compliance with the 2000 ppm standard based on basic principles of chemistry and combustion engineering.

From our discussions, it is apparent that USEPA officials feel they do not have sufficient information to accept that monitoring H2S prior to combustion and calculating SO2 concentration using stoichiometric methods is equivalent to monitoring SO2 after combustion. WRS recognizes the USEPA's desire to have an accurate measurement of the actual emission from the combustion device and would be willing conduct stack testing if the combustion source were more amenable to testing. WRS operates open flares

RK & Associates, Inc.

to combust the landfill gas collected from the gas collection system. As we stated during the July 8th meeting, there are no USEPA-accepted stack testing methods to measure SO2 emissions from an open flare. WRS is not aware of any standard test methods, whether promulgated by USEPA or any State regulatory agency, for measuring the SO2 emissions from an open flare.

As you know, 40 CFR 60.752(b)(2)(iii)(A) specifies that open flares are an acceptable control device for combusting landfill gas and that an open flare has a minimum combustion efficiency of 98% or greater. Requiring WRS to provide a stack test on an approved control device for which there is no corresponding standard test method is not a reasonable request and inconsistent with the rules which authorize the use of open flares.

Recognizing that USEPA has routinely authorized the use of mass balance calculations, engineering analysis, and stoichiometric calculations for emissions sources regulated by the Clean Air Act, we investigated why using combustion calculations in our situation was not acceptable to USEPA. What we determined was quite the opposite.

In the context of promulgating regulations pursuant to Section 111 of the Clean Air Act, specifically the New Source Performance Standards applicable to Petroleum Refineries, USEPA has authorized the monitoring of H2S concentrations in refinery fuel gas to demonstrate compliance with the allowable concentration of SO2 in the emissions from the combustion device utilizing that fuel gas. In Attachment 3, WRS is providing a copy of the Federal Register publication for the October 2, 1990 final rulemaking amending the 40 CFR Part 60 Subpart J NSPS for Petoleum Refineries to authorize monitoring of H2S in the fuel gas prior to combustion as an equivalent method of monitoring the SO2 concentrations in emissions from the combustion device. We can not envision a more positive affirmation by USEPA acknowledging the use of combustion calculations to establish the correlation between H2S concentrations in the fuel and SO2 emissions from the combustion device utilizing that fuel.

Flare Relocation Design and Operations Summary (Attachment 4)

At the request of the USEPA, WRS is providing the current plans for the relocation of the flares to a new location that is adjacent to the Winnebago Energy Center. We are also providing a summary of the process control steps for automation of the flare operations that are designed to reduce the potential for loss of vacuum on the collection system. This information is provided in Attachment 4.

Conclusion

WRS is very concerned about citizen complaints regarding objectionable odors that may be attributable to our operations and will continue to assess operational and design changes at the Winnebago Landfill Facility to ensure that the facility has a minimal impact on the surrounding area. WRS is also very concerned about the lack of resolution of the NOV, since that appears to be the reason why no progress is

RK & Associates, Inc.

being made on receiving the agency approvals for proposed design and operational changes requested by WRS. Many of the design and operational plans were requested 4 months prior to receiving the NOV and have been pending for nearly 12 months. The lack of resolution on this issue is hindering WRS' ability to operate the Winnebago Landfill Facility in a manner that minimizes the impact on the surrounding area. It is our hope that the additional information submitted in this correspondence will lead to a timely resolution of the issues cited in the NOV.

If you have any questions, please do not hesitate to contact Mr. Tom Hilbert of Winnebago Reclamation Services at 815-963-7516 or by e-mail at thilbert@wcwastecompanies.com or me at 630-393-9000 or by e-mail at jpinion@rka-inc.com.

Yours very truly,
RK & Associates

John Pinion
Associate Engineer

cc: Tom Hilbert – Winnebago Reclamation Services
Jon Faletto – Hinshaw Culberson, LLC
Jesse Varsho – Shaw Environmental

RK
& Associates, Inc.

Response to Request for Supplemental Information In Response to USEPA Notice of Violation EPA-5-10-07-IL
Winnebago Reclamation Service – Winnebago Landfill Facility
Rockford, Illinois

July 23, 2010

Attachment 1

North Flare Compliance Status
(Prepared by RK & Associates)

2 South 631 Route 59; Suite B
Warrenville, IL 60555

(630) 393-9000
Fax (630) 393-9111

RK
& Associates, Inc.

ATTACHMENT 1

NORTH FLARE COMPLIANCE STATUS

Item 31 of USEPA's February 4, 2010, Notice and Finding of Violation (EPA-5-10-07-IL) issued to Winnebago Reclamation Service (WRS) alleged that "*By emitting sulfur dioxide in excess of 1.24 pounds per hour from the North Flare, WRS is in violation of Title V Operation Permit Condition 7.1.6(a).*"

During the March 9, 2010 conference with USEPA and as part of their April 9, 2010, written response prepared by Shaw Environmental, Inc. (Attachment 3), WRS presented 2008 and 2009 data that demonstrated that the calculated actual hourly sulfur dioxide (SO_2) emission rate from the north flare had **not** exceeded the permitted hourly emission limit of 1.24-lb/hr. This compliance demonstration was based North Flare operating data consisting of landfill gas flow rates measured at the inlet of the flare and available landfill gas sulfur compound concentration analyses.

During the July 8, 2010, conference with USEPA, the Agency indicated that there were additional landfill gas analyses that were not included in WRS' initial compliance demonstration that, in the Agency's opinion, indicate that the permitted hourly SO_2 emission rate was exceeded. Specifically, USEPA was referring the following data submitted in a recent IEPA construction permit application (Page 3 of the July 31, 2009, *Winnebago Landfill Amendment to Construction Permits No. 02040025 and No. 04120073 Application)* for modification of the North Flare and South Flare emission rates.

North Unit LFG			
Date of Sampling	H_2S Lab Result, ppmv	TRS Lab Result, ppmv	Laboratory
01/07/2008	520	527	AnSol
08/20/2008	185.6	188	AnSol
04/30/2009	64.6	65.7	Atm AA
06/11/2009	81.8	83	Atm AA

The above data identify results from two landfill gas sulfur compound analyses performed by Analytical Solutions, Inc. (AnSol) in January and August of 2008. Although the above data were included in the IEPA construction permit application, they were not further considered in setting the proposed revised SO_2 emission limit for the North Flare, which is based on a maximum anticipated TRS concentration of 100-ppmv.

WRS believes that the January and August 2008 AnSol TRS analytical results are unreliable due to poor quality control in sampling handling and analysis and as a result are not representative of actual landfill gas sulfur content. Consistent with this belief, WRS changed laboratories in April 2009 and considers all three sets of AnSol analytical data (January 2008, August 2008 and April 2009 [47.8-ppmv TRS]) as being unreliable and therefore did not consider any of the AnSol analytical results in the initial April 9, 2010, North Flare compliance demonstration. This conclusion was based on the following information.

- Telephone conversations with laboratory personnel indicated to WRS that there may have been internal quality control issues that resulted in erroneous results.
- The wastes placed in the North Unit were representative of "typical municipal solid waste" and did not include high sulfur content waste streams that WRS believes are impacting the South Unit landfill gas sulfur content. Therefore, no significant variations in the North Unit TRS concentrations are anticipated.
- The January and August 2008 samples were collected approximately seven years after final closure of the North Unit when the gas generation rate and constituent levels are expected to be stable and not subject to

wide short term variations. Installation of an impervious layer as part of the final cover eliminates moisture infiltration into the waste which is a primary factor in the variability of TRS concentrations in landfill gas.

- There were no physical changes to the North Unit gas collection wells and header system at the time the January and August 2008 gas samples were collected that could have contributed to the higher than anticipated TRS levels in the gas.
- The January and August 2008 results are significantly higher than any previous or subsequent sampling results (see Figure 1 to this attachment). The January and August 2008 sample results fall well beyond the normal variance exhibited the 14 subsequent sample results obtained to date.

Based on the above, WRS believes that the AnSol results are unreliable and are not representative of the actual North Unit landfill gas sulfur content. To further illustrate the unexpected and uncharacteristic nature of the January and August 2008 analytical results, a summary of all available North Unit landfill gas sulfur content data is presented in Figure 1 and Table 1.

Figure 1 shows that the January and August 2008 TRS analytical results are clearly outliers with respect to the previous and subsequent TRS results. To further illustrate this observation, a trend line representing a linear regression analysis of all North Unit TRS concentration data (except the AnSol data) has been included on Figure 1.

Table 2 presents a summary of available North Unit landfill gas TRS data. The reported TRS concentration in any month is combined with the maximum hourly average landfill gas flow rate during that month to estimate the corresponding hourly SO_2 emission rate for comparison to the applicable permitted SO_2 emission limit. SO_2 emission rates are calculated using Equations 3 and 4 from *AP-42 Chapter 2.4 – Municipal Solid Waste Landfills, November 1998*, as described in the initial North Flare compliance demonstration submitted to USEPA dated April 9, 2010.

TRS data from samples taken prior to September 2002 (Table 2, Rows 1 through 5) represent landfill gas combusted in an enclosed flare with a rated landfill gas capacity of 1,000-scfm. Permitted emission limits for the enclosed flare are identified in Condition 7.1.6.(b) of the WRS' Title V permit (SO_2 hourly emission rate = 0.8-lb/hr). These data show that when the September 2001 TRS sample result of 150-ppmv is combined with the rated landfill gas flow rate for the enclosed flare, the resulting SO_2 hourly emission rate exceeds the applicable permit limit of 0.8-lb/hr. Actual flow data from September 2001 is not available so the maximum design landfill gas flow rate for the enclosed flare was used to represent a worst case value. Although, these data indicate an apparent exceedance of the applicable SO_2 hourly emission limit, the reported TRS concentration is significantly higher than expected and does not appear to be representative of historical data.

TRS data from samples taken from September 2002 through the present (Table 2; Rows 6- 40) represent landfill gas combusted in the existing North Flare with a rated landfill gas capacity of 2,500-scfm. Permitted emission limits for the North Flare are identified in Condition 7.1.6.(a) of the WRS' Title V permit (SO_2 hourly emission rate = 1.24-lb/hr). The reported TRS concentration for each month was combined with the maximum hourly landfill gas flow rate obtained from facility records. North Flare gas flow rate data is recorded as average gas flow rates for each 15-minute increment. In the initial North Flare compliance demonstration, the reported gas flow rate was the maximum 15-minute average gas flow rate occurring during the month. The North Flare landfill gas data presented in Table 1 (attached) has been revised to reflect the maximum "hourly" landfill gas flow rate calculated from a rolling 1-hour average of the 15-minute increment data. With the exception of the January 2008 TRS analysis (performed by AnSol and considered by WRS to be unreliable as described above) there are no exceedences of the applicable 1.24-lb/hr SO_2 emission limit.

Table 1 – Revised Summary of North Flare Compliance with SO2 Hourly Emission Limit
Winnebago Reclamation Service – Rockford, Illinois

Row #	Flare	Analytical Date	Total TRS as H_2S ppmV		LFG Moisture (sat @70°F) % Vol	Flare Peak LFG Flow scfm	Adjusted Flare Peak LFG Flow dscfm	Flare Control Efficiency	Flare Flare S Loading lb/hr	Flare Peak SO2 Emis lb/hr	Permitted SO2 Limit lb/hr	Actual Flare Monthly Op. Hours
1	Enclosed	04/01/94	0.20	a	2.81%	1,000	972	98.00%	0.00	0.00	0.80	720.00
2	Enclosed	11/01/94	0.22	a	2.81%	1,000	972	98%	0.00	0.00	0.80	720.00
3	Enclosed	03/27/01	49.90	a	2.81%	1,000	972	98%	0.24	0.47	0.80	744.00
4	Enclosed	09/04/01	150.00	a	2.81%	1,000	972	98%	0.71	1.42	0.80	720.00
5	Enclosed	04/03/02	73.50	a	2.81%	1,000	972	98%	0.35	0.70	0.80	720.00
6	North	09/29/02	54.50	a	2.81%	1,397	1,358	98%	0.36	0.72	1.24	720.00
7	North	03/13/03	62.10	a	2.81%	1,397	1,358	98%	0.41	0.82	1.24	744.00
8	North	01/07/08	527.00	c	2.81%	990	962	98%	2.47	4.95	1.24	252.25
9	North	no test	85.00	b	2.81%	990	962	98%	0.40	0.80	1.24	252.25
10	North	no test	85.00	b	2.81%	575	558	98%	0.23	0.46	1.24	5.25
11	North	no test	85.00	b	2.81%	656	637	98%	0.26	0.53	1.24	28.75
12	North	no test	85.00	b	2.81%	663	644	98%	0.27	0.53	1.24	11.00
13	North	no test	85.00	b	2.81%	1,197	1,163	98%	0.48	0.96	1.24	175.75
14	North	no test	85.00	b	2.81%	0	0	98%	0.00	0.00	1.24	0.00
15	North	no test	85.00	b	2.81%	633	615	98%	0.26	0.51	1.24	192.75
16	North	no test	85.00	b	2.81%	606	589	98%	0.24	0.49	1.24	5.25
17	North	08/21/08	188.00	c	2.81%	606	589	98%	0.54	1.08	1.24	5.25
18	North	no test	85.00	b	2.81%	138	134	98%	0.06	0.11	1.24	0.75
19	North	no test	85.00	b	2.81%	871	847	98%	0.35	0.70	1.24	4.25
20	North	no test	85.00	b	2.81%	585	569	98%	0.24	0.47	1.24	4.50
21	North	no test	85.00	b	2.81%	455	442	98%	0.18	0.37	1.24	5.00
22	North	no test	80.80	b	2.81%	1,397	1,358	98%	0.54	1.07	1.24	53.00
23	North	02/29/09	80.80	b	2.81%	722	702	98%	0.28	0.55	1.24	11.50
24	North	no test	80.80	b	2.81%	691	671	98%	0.26	0.53	1.24	119.00
25	North	04/06/09	48.70	c	2.81%	793	771	98%	0.18	0.37	1.24	4.75
26	North	04/29/09	65.70	b	2.81%	793	771	98%	0.25	0.49	1.24	4.75
27	North	no test	83.00	b	2.81%	0	0	98%	0.00	0.00	1.24	0.00
28	North	06/10/09	83.00	b	2.81%	491	477	98%	0.19	0.39	1.24	17.50
29	North	no test	83.00	b	2.81%	425	413	98%	0.17	0.33	1.24	153.75
30	North	08/10/09	74.30	b	2.81%	312	303	98%	0.11	0.22	1.24	3.50
31	North	09/22/09	84.20	b	2.81%	370	359	98%	0.15	0.30	1.24	29.25
32	North	10/21/09	83.50	b	2.81%	381	370	98%	0.15	0.30	1.24	32.50
33	North	11/24/09	84.80	b	2.81%	401	390	98%	0.16	0.32	1.24	130.50
34	North	12/16/09	80.80	b	2.81%	932	906	98%	0.36	0.71	1.24	6.50
35	North	01/19/10	110.00	d	2.81%	746	725	98%	0.39	0.78	1.24	3.25
36	North	02/17/10	77.80	d	2.81%	404	392	98%	0.15	0.30	1.24	14.75
37	North	03/18/10	74.60	d	2.81%	391	380	98%	0.14	0.28	1.24	89.25
38	North	04/15/10	72.40	d	2.81%	477	464	98%	0.16	0.33	1.24	33.50
39	North	05/12/10	72.20	d	2.81%	395	384	98%	0.14	0.27	1.24	6.25
40	North	06/15/10	73.30	d	2.81%	398	387	98%	0.14	0.28	1.24	205.87

a. Historical TRS not included in initial April 9, 2010, compliance demonstration.

b. TRS values used in initial April 9, 2010, compliance demonstration

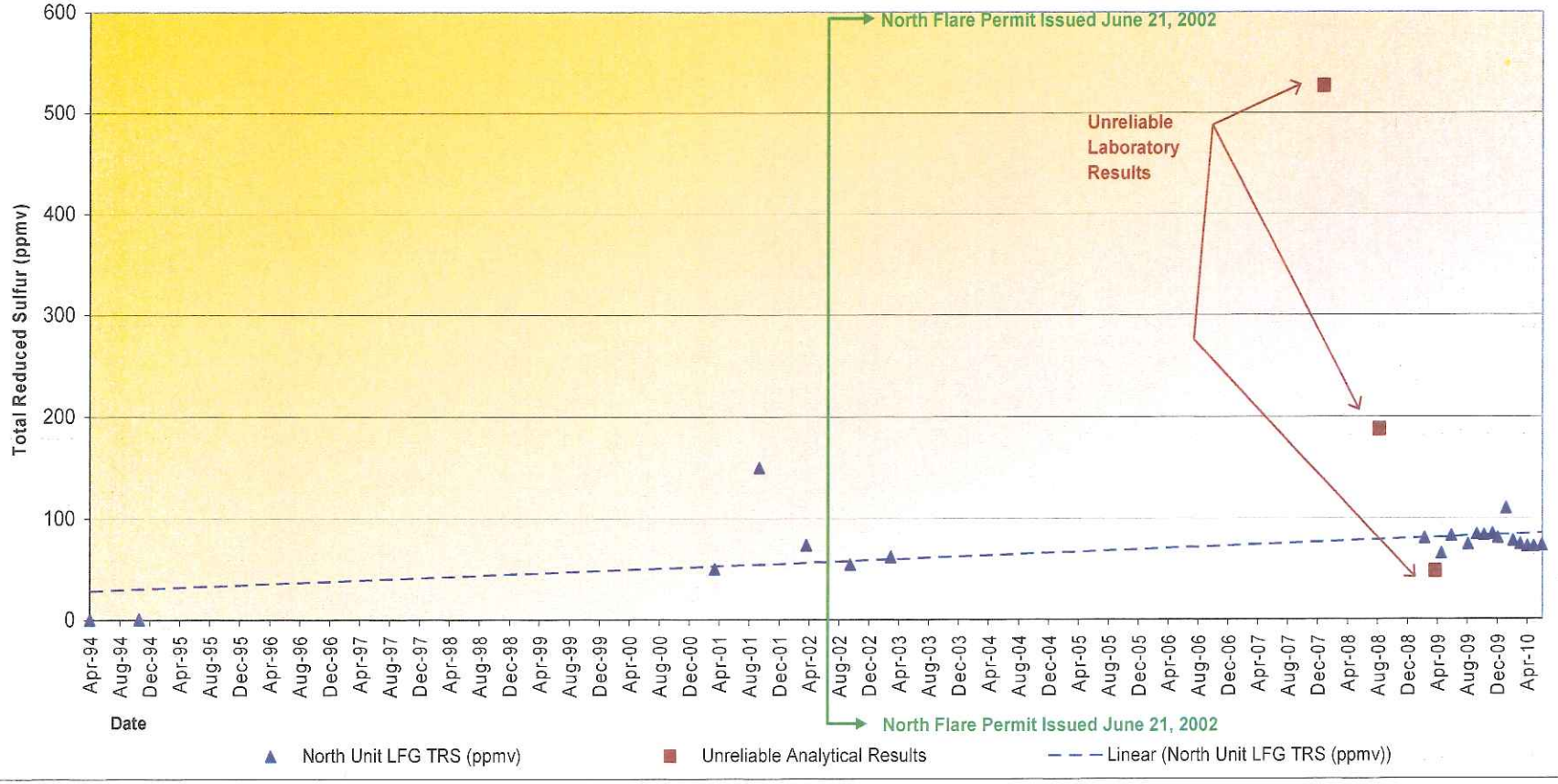
c. Suspect analytical results not included in initial April 9, 2010, compliance demonstration.

d. Recent TRS data that was not included in the initial April 9, 2010, compliance demonstration.

TRS values shaded in yellow represent estimated values for months for which there are no sampling results. Estimated values are based on results from preceding and subsequent months.

Flow rate values shaded in green represent estimated values. Values listed for the enclosed flare represent the design capacity of the flare (worst case flow rate). No flow data was available for the sampling vents shown in Rows 6 and 7. An assumed flow rate, equal to the maximum (worst case) flow rate from January 2008 through June 2010 was used.

Figure 1. Summary of North Unit Landfill Gas Total Reduced Sulfur Concentration
Winnebago Reclaimation Service - Rockford, Illinois



RK
& Associates, Inc.

Response to Request for Supplemental Information In Response to USEPA Notice of Violation EPA-5-10-07-IL
Winnebago Reclamation Service – Winnebago Landfill Facility
Rockford, Illinois

July 23, 2010

Attachment 2

Gas Collection System Design Review
(Prepared by Shaw Environmental)

2 South 631 Route 59; Suite B
Warrenville, IL 60555

(630) 393-9000
Fax (630) 393-9111

Memorandum

To: Tom Hilbert, William Charles Waste Companies

From: Jesse Varsho and Leia Cooney

Date: July 22, 2010

Subject: Gas Extraction Well Coverage at the Winnebago Landfill

Introduction

The existing Winnebago Landfill GCCS for the North and South Unit was evaluated to determine if additional gas extraction wells were needed. The landfill gas system must comply with applicable regulations for collection, maintaining negative pressure and maintaining emissions to less than 500 ppm above background.

In addition to the regulations that must be met, several design factors are used to determine the number of wells necessary at a landfill to provide adequate gas management, including: waste composition and age, depth of waste, leachate recirculation, and well efficiency. The existing GCCS radius of influence and well density was then compared to similar facilities in the Midwest.

GCCS Evaluation

Applicable Regulations

- 35 IAC Section 220.240(b): All wells shall be installed within 60 days of the initial solid waste being in place 5 years or within 60 days of the landfill being at closed or at final grade for two years.
    - All of the wells have been installed within the specified time frame; in fact the wells within the 2010 final cover installation area were installed within three months of the installation of the final cover.
- 35 IAC 220.240(a)(3): Monthly monitoring shall be performed to determine if positive pressure exists, in which case the exceedance must be corrected within five days.
    - The GCCS is tuned and in compliance. There have been no instances at the Winnebago Landfill where detected positive pressures were not corrected within five days.
- 35 IAC 220.240(c): The collection system shall be monitored on a quarterly basis for readings above 500 ppm above background.
    - Since the installation of the GCCS, all of the required quarterly monitoring events have been performed and have not resulted in any readings above 500 ppm above background.

Design Criteria

In addition to complying with the applicable regulations, the landfill gas design was compared to similar landfills in the Midwest. The GCCS at eight landfills were compared to the GCCS at the Winnebago Landfill. Seven of the landfills that were compared to the Winnebago Landfill were open and one was closed. Three of the landfills are located just outside Milwaukee, Wisconsin and accept waste from the Chicago area. Five of the landfills are located throughout the state of Illinois. The landfills used in the comparison accept between 500 and 6,000 tons per day. The total well density at the Winnebago Landfill is the second highest of the nine landfills compared. The Winnebago Landfill is also one of only three of the landfills in the study to incorporate horizontal collectors into the landfill gas collection system. A chart showing the number of landfill gas collectors per acre by type is attached. Figures 1 and 2 which show the location of the wells as they relate to the unit boundaries and final cover scenarios are attached. The well density was analyzed for several portions of the landfill and as seen in the attached table, shows that the well density is similar across the landfill and only varies by approximately 13 percent. The table also shows that the highest density of wells in the 2010 final cover installation area.

The Winnebago Landfill was also evaluated for effective coverage of the existing wells. A GCCS design rule of thumb for the radius of influence for gas extraction wells at a MSW landfill is 150 to 200 feet. It was conservatively assumed that the radius of influence at the Winnebago Landfill is 150 feet. The attached Figure 3 shows that the landfill is covered using a radius of influence of 150 feet for each of the vertical wells.

Conclusions

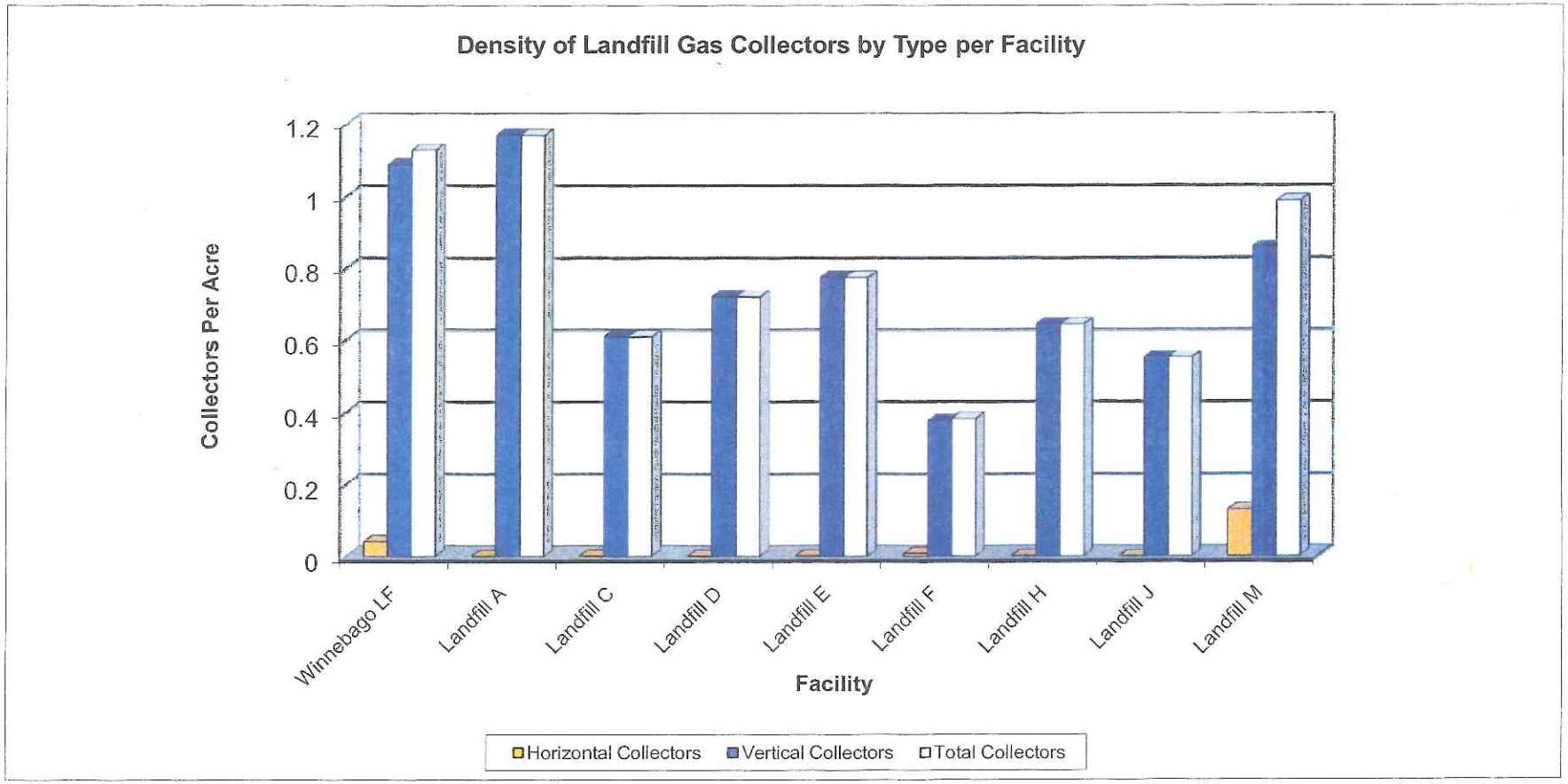
The Winnebago landfill is in compliance with the applicable regulations that would require additional gas collectors on account of: collectors being placed within the specified timeline, proper monitoring of the GCCS for positive pressure and monitoring for increases in methane at the landfill. The landfill has the second highest well density compared to that of other MSW landfills studied in the Midwest. Using a radius of influence of 150 feet for each of the vertical wells, the landfill has coverage of 95-99 percent. Based on compliance with the regulations, the high well density and the adequate coverage of the existing wells, no additional landfill gas extraction wells are necessary at the Winnebago Landfill.

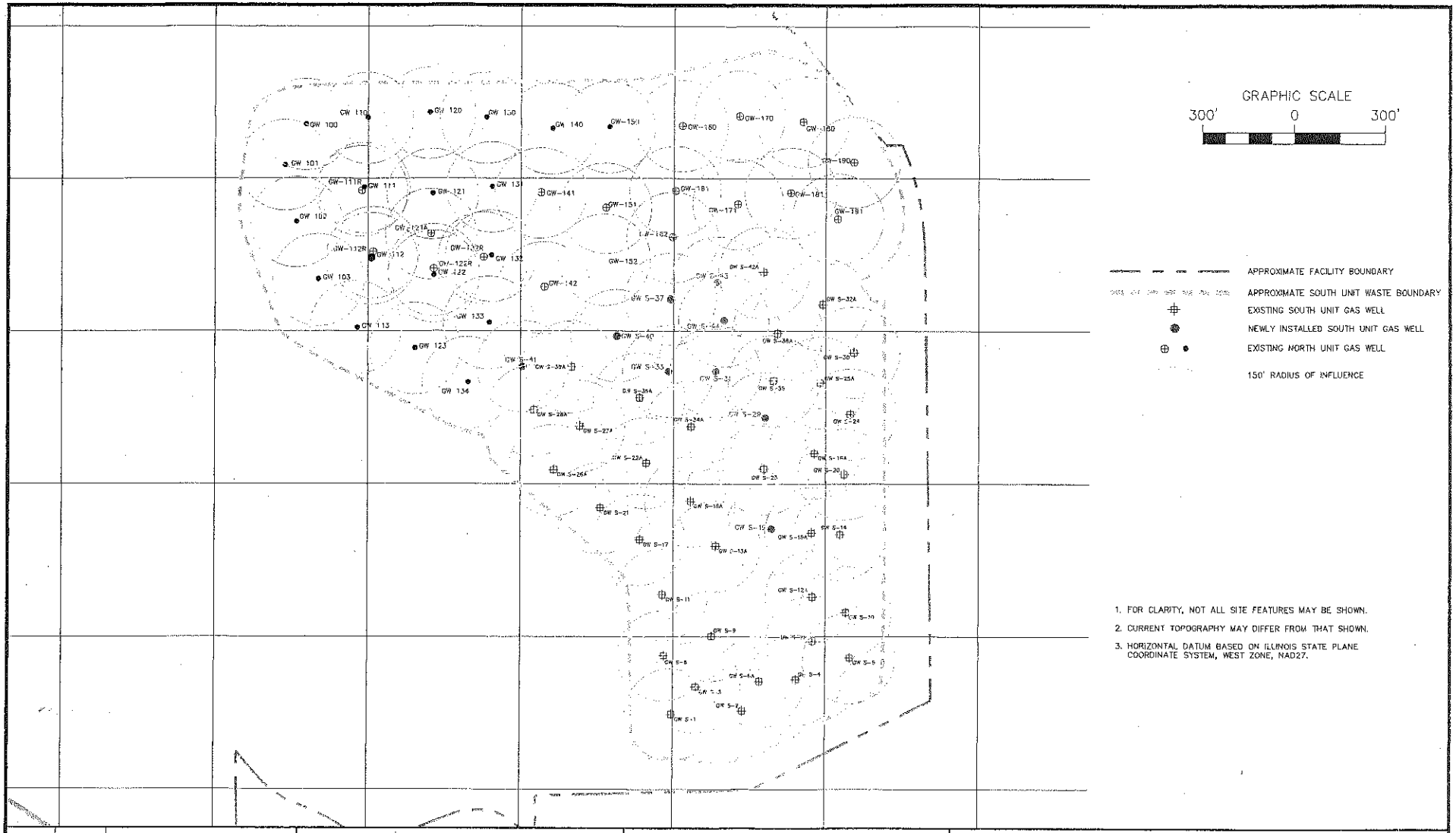
Finally, the addition of landfill gas extraction wells to the Winnebago Landfill could have negative impacts. Additional wells could create oxygen intrusion which could cause fires within the landfill, it can be difficult to balance wells where radiuses of influence are overlapping, and the penetration of the final cover could result in additional rain and/or oxygen entering into the landfill.

Vertical Well Density

Winnebago Landfill
Rockford, Illinois

Area Name	Area (ac)	Number of Vertical Wells	Well Density (well/ac)
North Unit	42.7	45	1.05
South Unit	31.9	36	1.13
Final Cover - North Unit	33.2	37	1.11
Final Cover 2010	16.63	20	1.20
Final cover 2011	22.6	24	1.06
Total Area	74.6	81	1.09





REV. NO.	DATE	DESCRIPTION

Winnebago Landfill

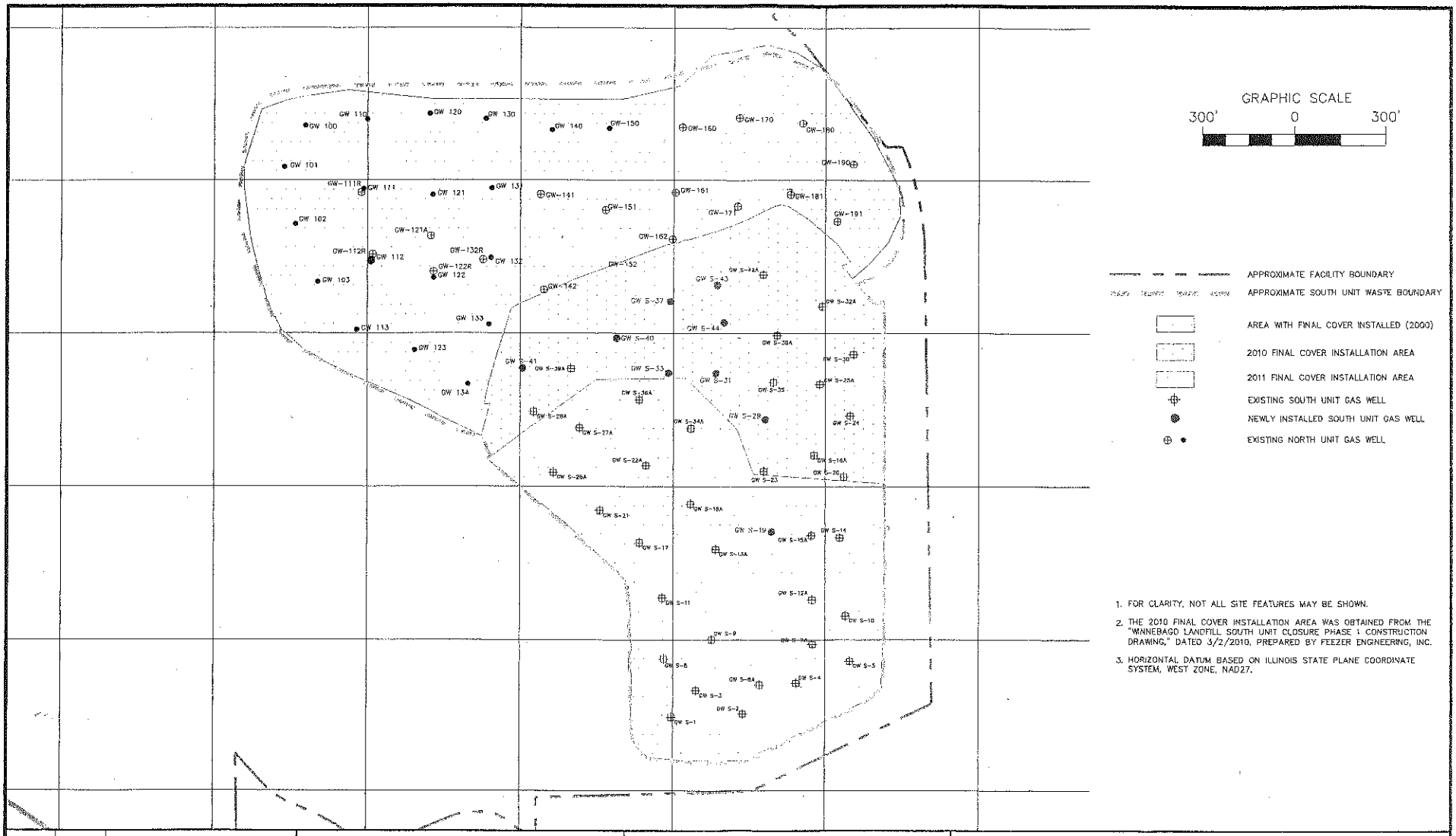
Shaw Environmental, Inc.

WINNEBAGO LANDFILL
ROCKFORD, ILLINOIS

FIGURE 3
GAS WELL - 150' RADIUS OF INFLUENCE

DRAWN BY:	LJC	APPROVED BY:	LJC	PROJ. NO.:	137863	DATE:	JULY 2010

T:\AutoCAD\Projects\137863\dwg\Odor\Radius of Influence.dwg, 7/21/2010 4:03:31 PM



1. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
2. THE 2010 FINAL COVER INSTALLATION AREA WAS OBTAINED FROM THE "WINNEBAGO LANDFILL SOUTH UNIT CLOSURE PHASE 1 CONSTRUCTION DRAWING," DATED 3/2/2010, PREPARED BY FEEZER ENGINEERING, INC.
3. HORIZONTAL DATUM BASED ON ILLINOIS STATE PLANE COORDINATE SYSTEM, WEST ZONE, NAD27.

REV. NO.	DATE	DESCRIPTION

Winnebago Landfill

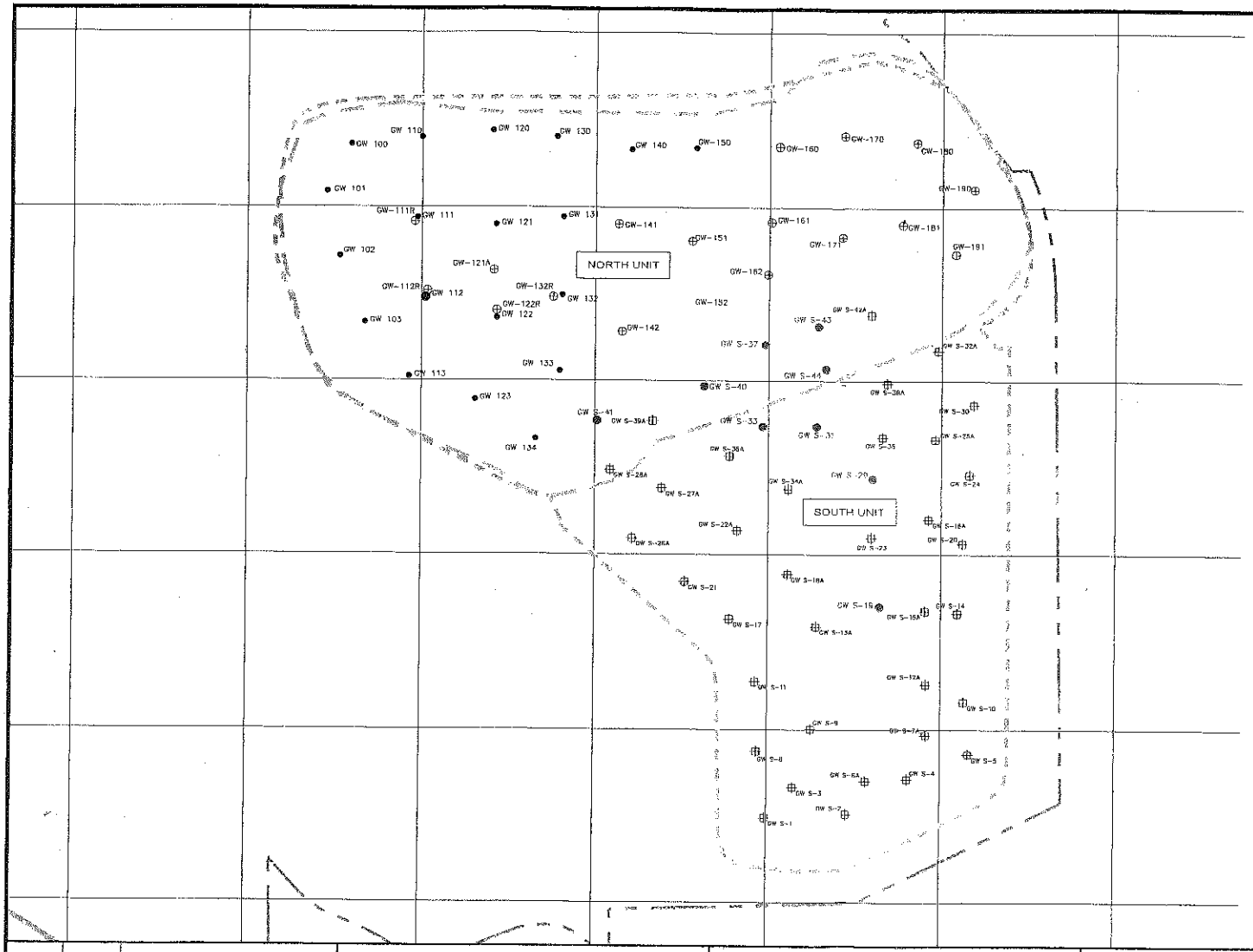
Shaw Environmental, Inc.

WINNEBAGO LANDFILL
ROCKFORD, ILLINOIS

FIGURE 2
GAS WELL LOCATIONS - FINAL COVER INSTALLATION

DRAWN BY:	LJC	APPROVED BY:	LJC	PROJ. NO.:	137863	DATE:	JULY 2010

T:\AutoCAD\Projects\137863\dwg\Odor\Well Locations - Final Cover.dwg, 7/21/2010 4:01:02 PM



GRAPHIC SCALE

300' 0 300'

LEGEND

- APPROXIMATE FACILITY BOUNDARY
- APPROXIMATE NORTH UNIT WASTE BOUNDARY
- APPROXIMATE SOUTH UNIT WASTE BOUNDARY
- EXISTING SOUTH UNIT GAS WELL
- NEWLY INSTALLED SOUTH UNIT GAS WELL
- EXISTING NORTH UNIT GAS WELL

NOTES

1. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
2. CURRENT TOPOGRAPHY MAY DIFFER FROM THAT SHOWN.
3. HORIZONTAL DATUM BASED ON ILLINOIS STATE PLANE COORDINATE SYSTEM, WEST ZONE, NAD27.

REV. NO.	DATE	DESCRIPTION

Winnebago Landfill

Shaw Environmental, Inc.

WINNEBAGO LANDFILL
ROCKFORD, ILLINOIS

FIGURE 1
GAS WELL LOCATIONS - NORTH AND SOUTH UNITS

DRAWN BY:	LJC	APPROVED BY:	LJC	PROJ. NO.:	137863	DATE:	JULY 2010

T:\AutoCAD\Projects\137863\dwg\Odor\Well Locations.dwg, 7/21/2010 4:04:34 PM

RK
& Associates, Inc.

Response to Request for Supplemental Information In Response to USEPA Notice of Violation EPA-5-10-07-IL
Winnebago Reclamation Service – Winnebago Landfill Facility
Rockford, Illinois

July 23, 2010

Attachment 3

Demonstration of Compliance with SO_2 Concentration Limit of 35 IAC 214.301

(Prepared by RK & Associates)

2 South 631 Route 59; Suite B
Warrenville, IL 60555

(630) 393-9000
Fax (630) 393-9111

RK
& Associates, Inc

ATTACHMENT 3

Demonstration of Compliance with SO_2 Concentration Limit of 35 IAC 214.301

Item 39 of USEPA's February 4, 2010, Notice and Finding of Violation (EPA-5-10-07-IL) issued to Winnebago Reclamation Service (WRS) alleged that "*By emitting greater than 2,000-ppm of sulfur dioxide from its flares, WRS is in violation of 35 IAC § 214.30.*"

During the March 9, 2010 conference with USEPA and as part of their April 9, 2010, WRS presented a detailed discussion and sample calculations that demonstrated compliance with the referenced 2,000-ppm sulfur dioxide (SO_2) concentration limit using widely accepted principals and equations describing stoichiometric combustion of methane in ambient air. This analysis showed that under anticipated worst case conditions of 4,000-ppmv total reduced sulfur (TRS) in the landfill gas and zero percent excess oxygen in the flare exhaust, the resulting flare emissions would contain less than 750-ppmv SO_2. Based on this analysis, WRS proposed to periodically monitor TRS in the landfill gas and calculate the corresponding equivalent SO_2 emissions in the flare exhaust under assumed combustion conditions as described in the initial submittal.

This approach to demonstrating compliance was selected because there are no USEPA approved methods for direct measurement of emissions from an open flare. USEPA has stated in technical documents and regulatory determination letters that direct measurement of mass emission rates or outlet concentrations in the exhaust from an open flare is not feasible. [1],[2]

---

[1] U.S. EPA OAQPS. *Municipal Solid Waste Landfills Volume 1: Summary of the Requirements for the New Source Performance Standards and Emission Guidelines for Municipal Solid Waste Landfills – FINAL.* EPA-453R/96-004. February 1999; Page 2-14:

> "Measurement of percent reduction or outlet concentration is not feasible for open flares. Flares meeting the specifications in § 60.18 are presumed to achieve 98% control, and a performance test is not required. However, § 60.18 does require a visible emission determination."

[2] U.S. EPA MACT Determination Detail; Control Number M000009; Donald Toensing U.S. EPA to Steve Feeler; November 24, 1994.

> ..... An August 1989 Report titled "Inspection Manual for Enforcement of New Source Performance Standards: Bulk Gasoline Terminals; August 1989. Under the performance testing section of the report on Page 7-1 it states:
>
> "Some flare type control systems may have to be testing using alternate methods, such as those found in 40 CFR 60.18 (Appendix B contains the flare testing requirements and Appendix C discusses further the testing of combustor systems)."
>
> In Appendix C of the report, on page C-4 it states:
>
> "The requirements and test methods for incineration and certain flare systems are different. Traditional incineration system contain an enclosed combustion chamber are tested using Method 2B (see Section 60.503(c)(1)(i)), in combination with methods 2A, 10, 25A, and 25B. The mass emission limits of the NSPS, 35 or 80-mg/liter, applies to this type of a system.
>
> A newer type of oxidation system resembles a vertical stack within which combustion of loading vapors occurs either at the top of the unit or down toward the bottom. This letter type of system (which can be considered an enclosed flare) consists of a refractory lined stack which can be source testing using the prescribed methods (2B, 25A, 25B). The NSPS emission limits also apply to enclosed flares. Figure C.1 shows a test setup that applies to the enclosed flare (or incineration) type system.
>
> The open flare system (top-mounted flame) cannot be tested for compliance with an emission limit due to the absence of an enclosed exhaust area in which emitted gases can be measured. For these systems, compliance has been assessed by application of the regulation for petroleum refinery flares (40 CFR 60.18), which specifies a minimum net heating value of at least 300 Btu/scf for steam assisted or air-assisted flares, and 200 Btu/scf if the flare in non-assisted....."

For instances where open flares are allowed for emissions control, USEPA provides alternate compliance demonstration procedures specified in 40 CFR 60.18 based on flare tip velocity and net heating value of the gas being combusted or allows monitoring of H_2S in the fuel gas to demonstrate compliance with an equivalent limit for SO_2 concentration in the exhaust.

It is not reasonable under these circumstances to impose on WRS the burden of developing and demonstrating a test method for open flares when there are clearly acceptable alternative methods available which more than amply demonstrate compliance with the applicable flare performance and emission standards.

During our July 8, 2010, meeting, USEPA stated that there is insufficient information available to document the equivalence between the sulfur content of landfill gas and the corresponding concentration of SO_2 in the flare exhaust. Further USEPA stated it would "conservatively" consider the relationship between H_2S in the fuel gas and SO_2 in the exhaust gas on a 1:1 basis (i.e. 2,000-ppm H_2S in the fuel gas = 2,000-ppmv SO_2 in the fuel combustion exhaust gas) for the purposes of demonstrating compliance.

USEPA's assumption that SO_2 emissions from an open flare are approximately equal to the concentration of H_2S in the landfill gas is not a "conservative" position; it is simply wrong. That assumption ignores the basic principles of chemistry and stoichiometric combustion. There is no rationale and technically competent basis to support USEPA's assumption. It is not correct nor is it reasonable given the actual conditions under which H_2S in landfill gas is converted to SO_2 in the combustion process.

In response to these statements, WRS provided USEPA with references to the following New Source Performance Standards (NSPS):

- 40 CFR 60 Subpart J – Standard of Performance for Petroleum Refineries; and,
- 40 CFR 60 Subpart Ja – Standards of Performance for petroleum Refineries for Which Construction, Reconstruction, or Modification Commenced After May 14, 2007;

in which USEPA acknowledges that the concentration of SO_2 in the exhaust gas is "*substantially*" less than the corresponding H_2S concentration in the fuel gas and that the USEPA will rely on a mathematical equivalence between the concentration of H_2S in a fuel gas and the corresponding concentration of SO_2 in the exhaust gases from a combustion device to demonstrate compliance with applicable sulfur emission limits.

USEPA NSPS Regulations Subpart J and Ja

40 CFR 60 Subpart J [60.104(a)(1)] limits the H_2S concentration in fuel gas burned in a fuel gas combustion device. To demonstrate compliance with this limit, the monitoring requirements of this subpart provide the owner/operator with the option to monitor **either**:

- the concentration of SO_2 by volume (dry basis, zero percent excess air) in the exhaust gas [§60.105(a)(3)]; **or,**
- the concentration (dry basis) of H_2S in fuel gases before being burned in a fuel gas combustion device [§60.105(a)(4)].

40 CFR 60 Subpart Ja [60.102a(g)(1)] also provides the owner/operator with the option to demonstrate compliance with applicable sulfur emission limits by **either**:

- limiting SO_2 in the exhaust of fuel combustion devices to 20-ppmv (dry basis corrected to 0-percent excess air), [§60.102a(g)(1)(i)]; **or,**
- limiting H_2S concentration in the fuel gas to 162-ppmv [§60.102a(g)(1)(ii)].

In either case, Subpart J or Subpart Ja, USEPA has determined that H_2S in the fuel gas and SO_2 in the combustion device exhaust gases can be expressed as equivalent standards. The basis for this determination of equivalence is documented the preamble to the October 2, 1990 amendments to 40 CFR 60 Subpart J published in the Federal Register 55 FR 40171, October 2, 1990, which, at page 40172, states (emphasis added):

> The present monitoring requirements for fuel gas combustion devices under § 60.105(a) (3) and (4) allows the options of monitoring SO_2 after fuel gases are combusted or monitoring H_2S in the fuel gases. Since October 6, 1975 (40 FR 46250), affected facilities choosing to monitor H_2S in the fuel gases have been exempted from the monitoring requirements of § 60.105(a)(4) because PS's for H_2S CEMS's had not been established. This rulemaking will amend the emission monitoring requirements to end this exemption. The effect of this rulemaking will be to require affected facilities to monitor SO_2 after fuel gas combustion or, as an alternative, H_2S in the fuel gas.
>
> When fuel gases are burned in a combustion device, the H_2S is converted to SO_2. The resulting SO_2 concentration is **substantially less** than the corresponding H2S in the fuel gas due to dilution from added combustion air. The amount of dilution air required for complete fuel gas combustion hinges upon the makeup of fuel gas components (primarily hydrogen and hydrocarbons) and their stoichiometric need for oxygen. The EPA investigated a number of typical fuel gas compositions and their combustion products and determined that, at zero percent excess air, the concentration of SO_2 formed from combusting fuel gas containing H_2S at the standard level (162 ppm) ranged from 9 to 25 ppm with the majority of values between 15 and 20 ppm. This agrees with the 15- to 20-ppm SO_2 level noted in the background document to the proposed petroleum refineries standard.
>
> Realizing the complexity of establishing the SO_2 / H_2S equivalency on a case-by-case basis, EPA has selected 20 ppm to represent the compliance level for SO_2. In addition, rather than requiring monitoring of the effluent after each combustion device, EPA is allowing the

monitoring of SO_2 after only one of the combustion devices as long as that one location accurately represents the fuel gas being burned by all of the combustion devices.

It is clear from the above references that USEPA has determined that the concentration of SO_2 in the exhaust of a fuel combustion device is substantially less than the corresponding H_2S concentration in the fuel gas being burned. Based on the NSPS Subpart Ja sulfur emission standards, the approximate ratio is 20-ppmv H_2S in the exhaust gas will yield 1-ppmv SO_2 (dry basis, zero percent excess air) in the exhaust gases of a fuel combustion device.

Based on the conservative assumptions used in the March 9, 2010, SO2 concentration compliance demonstration submitted by WRS, the ratio of H2S in the fuel gas to SO2 in the exhaust gas was approximately 5.5:1. This indicates that the demonstration presented by WRS is even more conservative than the demonstration relied upon by USEPA in drafting the NSPS standards.

Alaska Department of Environmental Conservation

During the July 8, 2010, meeting with USEPA, WRS also referenced the fuel combustion sulfur emission limits in the Alaska Department of Environmental Conservation (ADEC) regulations. Like the Illinois Environmental Protection Agency's (IEPA's) fuel combustion sulfur emission limit (35 IAC 214.301), ADEC's maximum allowable SO_2 exhaust concentration is established as part of a federal enforceable rule contained in an approved State Implementation Plan (SIP).

The ADEC provides a guidance memo (http://www.dec.state.ak.us/air/ap/docs/sulfgas.pdf) dated October 27, 2000 (see attached), that describes combustion calculations used to determine the concentration of SO_2 in the exhaust gases from a fuel combustion device based upon the concentration of H_2S in the fuel gas. The stated purpose of the memo was to respond to USEPA's requirement to demonstrate that limiting H_2S concentration of natural gas to 4,000-ppmv will ensure compliance with ADEC's federally enforceable limit of 500-ppmv SO_2 in the exhaust from fuel combustion. It should be noted that ADEC's H2S concentration limit is also based on an 8:1 ratio of H_2S to SO_2 as identified in 40 CFR 60 Subpart Ja.

This memo, and the calculations provided are routinely referenced in the Statement of Basis issued by the ADEC as part of Title V permit. As you are aware, the Alaska DEC is required by Title V of the Act and USEPA's approval of the Alaska Title V Operating Permit program to provide USEPA Region X with an opportunity to review every draft Title V Operating Permit. Also provided are the public notice documentation and the Statement of Basis explaining how the proposed permit incorporates all applicable requirements and appropriate compliance assurance conditions. During USEPA's mandatory 45-day review period, USEPA can object if the agency determines that the proposed permit does not comply with federal or SIP requirements. Even after a Title V Permit is issued in final form, USEPA has yet another opportunity to object to the permit via a petition filed by a member of the public.

The Alaska DEC has issued more than a dozen Title V Operating Permits with conditions based on using combustion calculations to determine the concentration of SO2 in the exhaust gases from a fuel combustion device based upon the concentration of H2S in the fuel gas. We find no evidence to suggest that USEPA Region X objected to any of those Title V Permits due to the use of combustion calculations, nor has there been a single petition filed to challenge those permits.

Conclusion

It seems clear for the information presented herein that the USEPA currently relies on a mathematical equivalence between fuel gas H_2S concentration and combustion device exhaust gas SO_2 concentration to demonstrate compliance with federally enforceable sulfur emission limits. Although the references described above relate to the operation of refinery flares (open flares), it is also clear that this demonstration is directly applicable to open flares burning landfill gas containing sulfur compounds.

We feel that the initial compliance demonstration submitted to USEPA (RKA correspondence to IEPA dated March 8, 2010) adequately demonstrates compliance with the 2,000-ppm SO_2 emission limit applicable to the flare exhaust gases.

WRS looks forward to continuing this dialogue and will be happy provide any additional information as may be required by USEPA to complete their review of this issue.

Compliance Monitoring

Search Applicability Determination Index

ATTACHMENT 3
FOOTNOTE 1

Determination Detail

Control Number: M000009

Category: MACT
EPA Office: Region 7
Date: 11/24/1999
Title: Open Flame Flares
Recipient: Steve Feeler
Author: Donald Toensing
Comments:

Subparts: Part 63, R Gasoline Distribution Facilities

References: 63.11(b)
63.425(a)

Abstract:

Q: Do the requirements in section 63.11 apply in situations where open flame flares do not have an exhaust stack to allow for the collection and analysis of the emitted gases and test methods such as 2B, 25A, or 25B cannot be used?

A: Although EPA does not necessarily promote open flame flares as the preferred choice for a control device for either the gasoline distribution MACT or NSPS Subpart XX, these flares are allowed under both of these regulations. In these situations, sources should follow the criteria in section 63.11 and section 60.18 in order to demonstrate compliance with the MACT or NSPS Subpart XX, respectively. All other applicable performance test requirements under section 60.503 still apply.

Letter:

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VIII
901 NORTH 5TH STREET
KANSAS CITY, KANSAS 66101

NOV 24 1999

Mr. Steve Feeler
Missouri Department of Natural Resources
Air Pollution Control Program
P.O. Box 176
Jefferson City, Missouri 65102

Dear Mr. Feeler:

This is in response to your January 27, 1999 letter requesting clarification regarding performance testing requirements under the gasoline distribution MACT (Subpart R) and NSPS Subpart XX at several Conoco, Inc. bulk gasoline distribution facilities located in Missouri. In your letter and through discussion with my staff, you asked if EPA allowed a diminished flare test at facilities which use open flame flares (flares which are not enclosed and are open to the atmosphere). Specifically, the question was if the requirements in Section 63.11 and Section 60.18 should be followed in situations where open flame flares do not have an exhaust stack to allow for the collection and analysis of the emitted gases and test methods such as 2B, 25A, or 25B cannot be used.

Under Section 63.425(a) it states that "...if a flare is used to control emissions, and emissions from this device cannot be measured using these methods and procedures, the provisions of Section 63.11(b) shall apply." The methods referred to are contained in Section 60.503 and include methods such as 2B, 25A and 25B. In the background information document for the gasoline distribution MACT on page 5-10 (which originated in the preamble on page 5872) it states:

"Due to the inherent inability to measure mass emissions from elevated flares (elevated flare's flame is open to the atmosphere and therefore the emissions cannot be routed through stacks), these test methods are not applicable. Therefore, the Agency has established performance requirements for flares. These performance requirements, including a limitation on visible emissions, are provided in 63.11 of the proposed General Provisions, which specified Method 22 for determining visible emissions from this hard to test type of flare."

As discussed in the background information document, the use of open flame flares at bulk terminals and the need to specify performance requirements for these devices was recognized by EPA when the MACT standards were proposed. The regulations allow the use of open flame flares as a control device under the MACT standards. Source should follow the criteria in Section 63.11 when the mass emission measuring methods such as 2B, 25A, or 25B cannot be used. All other applicable performance test requirements under Section 60.503 would still apply (e.g. the testing procedures in Section 60.503(d)).

Since the gasoline distribution MACT standard emission limit is more stringent than the corresponding NSPS XX regulation (10 mg TOC/liter gasoline versus 35 mg TOC/liter gasoline), a similar approach would be reasonable to demonstrate compliance with the NSPS XX regulations. This is supported by an August 1989 report titled "Inspection Manual for Enforcement of New Source Performance Standards: Bulk Gasoline Terminals" which was distributed by cover memorandum signed by John S. Seitz, Director of Stationary Source Compliance Division, Office of Air Quality Planning and Standards. Under the performance testing section of the report, on page 7-1 it states:

"Some flare type control systems may have to be tested using alternative methods, such as those found in 40 CFR 60.18 (Appendix B contains the flare testing requirements and Appendix C discusses further the testing of combustor systems)."

In Appendix C of the report, on page C-4 it states:

"The requirements and test methods for incineration and certain flare systems are different. Traditional incineration systems contain an enclosed combustion chamber and are tested using Method 2B (see Section 60.503(c)(1)(i), in combination with Methods 2A, 10, 25A, and 25B. The mass emission limit of the NSPS, 35 or 80 mg/liter, applies to this type of system.

A newer type of oxidation system resembles a vertical stack within which combustion of loading vapors occurs either at the top of the unit or down toward the bottom. This latter type of system (which can be considered an enclosed flare) consists of a refractory lined "stack" which can be source tested using the prescribed methods (2B, 25A, 25B). The NSPS emission limits also apply to enclosed flares. Figure C.1 shows a test setup that applies to the enclosed flare (or incineration) type system.

The open flare type system (top-mounted flame) cannot be tested for compliance with an emission limit due to the absence of an enclosed exhaust area in which emitted gases can be measured. For these systems, compliance has been assessed by application of the regulation for petroleum refinery flares (40 CFR 60.18), which specifies a minimum net heating value of at least 300 Btu/scf for steam assisted or air-assisted flares, and 200 Btu/scf if the flare is non- assisted..."

Based on this information, the NSPS regulations allow the use of open flame flares as a control device and source should follow the criteria in Section 60.18 when the mass emission measuring methods such as 2B, 25A, or 25B cannot be used. All other applicable performance test requirements under Section 60.503 would still apply (e.g. the testing procedures in Section 60.503(d)).

Although EPA does not necessarily promote open flame flares as the preferred choice for a control device for either the gasoline distribution MACT or NSPS XX, it is clear from the background information documents and the regulations that open flame flares are allowed under both of these regulations. In these situations, sources should follow the criteria in Section 63.11 and Section 60.18 in order to demonstrate compliance with the MACT or NSPS XX respectively.

If an enclosed flare is used which can be source tested using methods such as 2B, 25A, or 25B, then these methods are to be used to demonstrate compliance with the mass emission limits under both the MACT and NSPS XX. The procedures under Section 63.11 and Section 60.18 would not apply in this situation.

This determination was reviewed and concurred upon by the Office of Enforcement and Compliance Assurance (OECA) and the Office of Air Quality Planning and Standards (OAQPS). If you have any questions regarding this response, you may contact Bill Peterson at (913) 551-7881.

Sincerely,

Donald C. Toensing
Chief
Air Permitting & Compliance Branch

cc: Jim Phelan, Conoco, Inc.
Julie Tankersley, OECA
Sally Mitoff, OECA
Steve Shedd, OAQPS

ATTACHMENT 3
FOOTNOTE 2

United States
Environmental Protection
Agency

Office of Air Quality
Planning and Standards
Research Triangle Park, NC 27711

EPA-453R/96-004
February 1999

Air

PB99-134983

EPA

Municipal Solid Waste Landfills, Volume 1:

Summary of the Requirements for the New Source Performance Standards and Emission Guidelines for Municipal Solid Waste Landfills

FINAL

ensure that the system is effectively extracting LFG from the landfill. If the monitoring results indicate problems, the gas collection system must be adjusted, as necessary, to maintain peak performance [§ 60.755(a)(3), (a)(5), and (d)(4)]. In some cases, upgrades to the collection system or installation of additional collection devices may be required to correct the problem.

Again, it should be noted that a Collection and Control System Design Plan can request alternatives to the pressure, temperature, nitrogen concentration, oxygen concentration, or surface methane monitoring and compliance provisions for landfill gas collection systems. The plan must provide a justification for the alternatives, and the State agency may approve or disapprove the proposed alternatives.

Collected LFG is vented through a network of piping to a BDT control device [§ 60.752(b)(2)(iii)]. The control device is operated at all times when collected LFG is routed into the control system [§ 60.753(f)] except during times of startup, shut down, or malfunction. This exception is allowed as long as the operational disruption for the collection system is 5 days or less [§ 60.755(e)]. In the event the collection system or control device becomes inoperable, the gas mover system must be shut down. All valves leading to atmospheric venting of LFG in the gas collection and control system must also be closed [§ 60.753(e)].

What Is the Required Gas Control Technology?

The BDT for controlling landfill emissions is routing collected LFG to a control device capable of reducing NMOC emissions by 98 weight-percent or reducing emissions to 20 parts per million by volume dry (ppmvd) as hexane. The efficiency or emission reduction achieved by the control technology must be demonstrated. Acceptable control devices for landfill emissions are open flares and enclosed combustion devices.

The emission reduction performance of an open flare can be demonstrated by using a flare that meets certain design and operating parameters [§ 60.752(b)(2)(iii)(A)]. These design and operating parameters have been specified in 40 CFR § 60.18 to ensure open flares achieve at least 98 percent destruction efficiency. Measurement of percent reduction or outlet concentration is not feasible for open flares. Flares meeting the specifications in § 60.18 are presumed to achieve 98 percent control, and a performance test is not required. However, § 60.18 does require a visible emission determination.

MEMORANDUM

State of Alaska

Department of Environmental Conservation
Division of Air and Water Quality - Air Quality Maintenance

TO: John F. Kuterbach, Program Manager DATE: October 27, 2000

THRU: Bill MacClarence, Operating Permits Supervisor

FROM: Matt Wilkinson
Air Quality Maintenance

SUBJECT: Maximum SO_2 Concentration from the combustion of natural gas

EPA in their Title V permit reviews is requiring the department to demonstrate that limiting hydrogen sulfide content of the natural gas to 4000 ppmv will ensure compliance with our 500 ppmv SO_2 limit. This memorandum sets forth engineering calculations which demonstrate that combustion of natural gas containing hydrogen sulfide up to 4000 ppmv will always comply with the 500 ppmv SO_2 limit regardless of the source involved. I recommend that we reference these calculations in future "statements of basis" that we send to EPA with our draft operating permits.

Summary

This engineering calculation examined the stoichiometric combustion of natural gas and calculated the maximum sulfur dioxide content of the flue gases. The maximum sulfur dioxide concentration will result from the combustion of pure methane, whereas heavier hydrocarbons (e.g. ethane or propane) with the same volumetric hydrogen sulfide concentration will result in a lower concentration of sulfur dioxide. Typically, combustion of 4000-ppmv-hydrogen sulfide natural gas can produce up to 470 ppmv SO_2 in the flue gas and will never exceed the 500ppm limit.

I conclude that combustion of 4000-ppmv-hydrogen-sulfide natural gas with air will always comply with the 500ppmv emission limit.

Assumptions

All constituents of the fuel are burned proportionally.
Any excess air typical of combustion would tend to dilute the SO_2 concentration of the flue gas, therefore only theoretical air is considered.
Natural gas is composed of carbon, hydrogen, sulfur, and negligible amounts of water and ash.
Ignore the water because the standard is a dry standard and the water will drop out of any calculations.
The heavier hydrocarbons have a higher weight percent of hydrocarbons for a given volumetric hydrogen sulfide concentration that dilutes the SO2 concentration of the flue gas, therefore the natural gas is entirely made up of methane—the lightest hydrocarbon.

By Dalton's Law and by the Ideal Gas Law, the molar fraction is equal to the volume fraction. Therefore, for 100 moles of 4000-ppmv-hydrogen sulfide natural gas there are 100 X (4,000 / 1,000,000) = 0.4 moles of hydrogen sulfide and there are 100 – 0.4 = 99.6 moles of hydrocarbons.

By definition, the formula showing the composition of hydrocarbons is C_mH_n. Each mole of hydrocarbon supplies "m" moles C and supplies "n"/2 moles H_2. Each mole of hydrogen sulfide supplies one mole S and one mole H_2.

Therefore, the following equations can be used for 100 moles of a natural gas composed of 4000-ppmv hydrogen sulfide and only of one type of hydrocarbon:

moles C = 99.6 X m
moles H_2 = (99.6 X n / 2) + 0.4

moles S = 0.4

Using normal air for combustion (79% N_2 and 21% O_2):

For each lb-mole of Oxygen in Air, there are 3.76 lb-mole Nitrogen (1 lb-mole O_2) = (0.79/0.21) = 3.76 lb-mole N_2

The stoichiometric equations are:
$C + O_2 + 3.76\ N_2 = CO_2 + 3.76\ N_2$
$2H_2 + 0_2 + 3.76\ N_2 = 2H_2O + 3.76\ N_2$
$S + 0_2 + 3.76\ N_2 = SO_2 + 3.76\ N_2$

To calculate the dry exhaust gases (CO_2, N_2, SO_2) the following equations are used:

moles CO_2 = moles C
moles N_2 = (3.76 X moles C) + (1.88 X moles H_2) + (3.76 X moles S)
moles SO_2 = moles S

Then, by Avogadro's Law and the definition of mole:

ppmv SO_2 = 1,000,000 x [moles SO_2/(moles CO_2 + moles N_2 + moles SO_2)]

Results

Using 100 moles of fuel (i.e. 99.6 moles of hydrocarbon and 0.4 moles of hydrogen sulfide) as a basis, we examined the following three cases:

Case	Moles of Fuel		
	Carbon	Hydrogen	Sulfur
Methane = CH_4	99.6	199.6	0.4
Ethane = C_2H_6	199.2	299.2	0.4
Propane = C_3H_8	298.8	398.8	0.4

	Methane	Ethane	Propane
moles CO_2	99.6	199.2	298.8
moles N_2	751.2	1313.0	1874.7
moles SO_2	0.4	0.4	0.4
Total Dry Moles	851.2	1512.6	2173.9
ppmv SO_2	470	264	184

Conclusion

The above calculations show that 4000-ppmv-hydrogen-sulfide natural gas combusted with air will always comply with the 500 ppmv SO_2 limit. The calculations use the conservative assumptions of complete combustion and no excess air. The real-world includes partial combustion and excess air, both of which would tend to dilute the SO_2 concentration in the exhaust effluent.

The equations above can be used as an initial screening for other gaseous petroleum fuels even with a higher hydrogen sulfide content.

If you agree this memorandum has value, please share it with the rest of the AQM staff.

RK
& Associates, Inc.

Response to Request for Supplemental Information In Response to USEPA Notice of Violation EPA-5-10-07-IL
Winnebago Reclamation Service – Winnebago Landfill Facility
Rockford, Illinois

July 23, 2010

Attachment 4

Flare Relocation Design and Operations Summary
(Prepared by WRS)

2 South 631 Route 59; Suite B
Warrenville, IL 60555

(630) 393-9000
Fax (630) 393-9111

ATTACHMENT 4

FLARE RELOCATION DESIGN AND OPERATIONS SUMMARY

The North and South disposal units of the Winnebago Landfill Facility have separate active gas collection systems. Each gas collection system (GCS) has a primary header piping system that is connected to a blower skid which has a fuel gas treatment system prior to distribution to the Winnebago Energy Center which is a landfill gas to electric facility utilizing internal combustion engines to power electric generators. The Winnebago Energy Center has separate engine rooms with a blower skid and fuel gas treatment system for each engine room to provide separation of the end use of the landfill gas from each disposal unit. The fuel gas treatment system on each blower skid is the primary control device for the landfill gas from both the North and South disposal units. Each disposal unit also has an open flare that serves as the back-up control device in the event that the Winnebago Energy Center is not utilizing enough landfill gas to provide sufficient vacuum on the collection system. The Winnebago Landfill Facility has proposed to relocate the flares to the area immediately north of the Winnebago Energy Center and retrofit the flare control system to provide for automatic startup to minimize any gas collection and control system downtime events.

The flare startup will be based upon collection system vacuum. Each flare will be retrofitted with a variable speed drive unit to control blower motor speed. The variable speed drive unit will be controlled by a PLC system that will utilize the collection system vacuum to determine the appropriate flare blower load. The PLC will initiate flare startup once the collection system vacuum falls to the minimum amount necessary to ensure adequate vacuum at each well head in the system. Flare shut down will occur once the vacuum reaches a point at which the collection system is overdrawing on the well field. The set points will be determined by well field balancing but, it is anticipated that the flare startup will occur once the collection system vacuum drops below 20 inches of H2O and shut down will occur at a vacuum of 40 inches of H2O.